

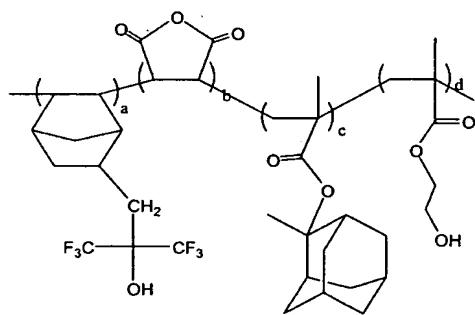
AMENDMENTS TO THE CLAIMS

Please cancel claims 1-3, amend claims 4-5 and 9 and add new claims 21-23
as follows:

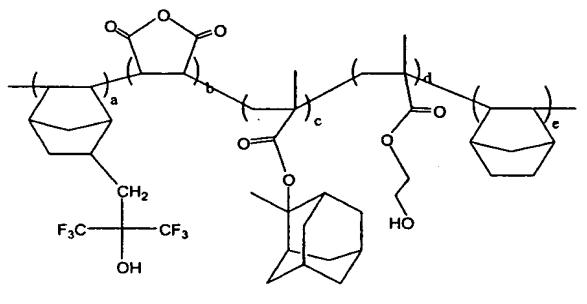
Claims 1-3 (cancelled)

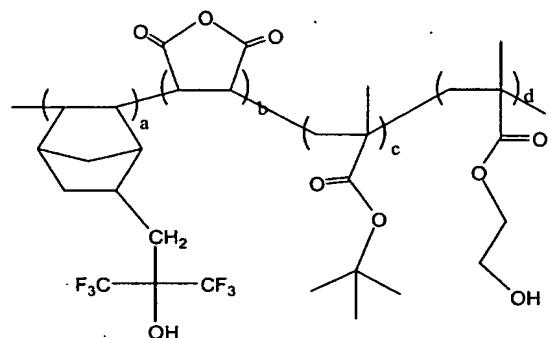
Claim 4 (currently amended) ~~The A photoresist polymer according to claim 3, wherein the polymer having repeating unit of Formula 1a is comprising a repeating unit selected from the group consisting of Formulas 1b to 1h:~~

Formula 1b

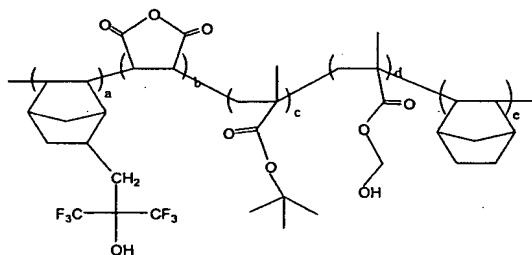


Formula 1c

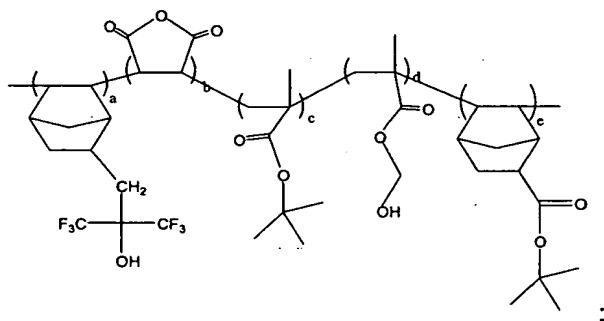


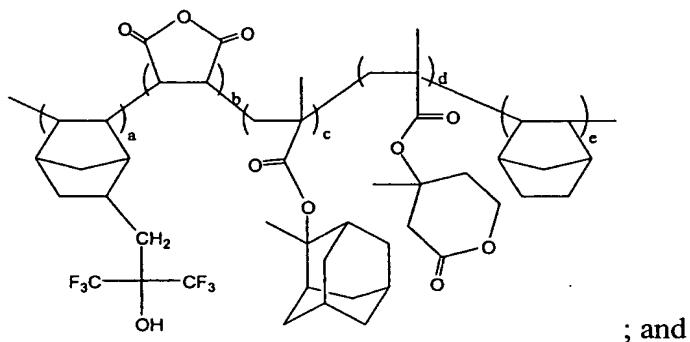
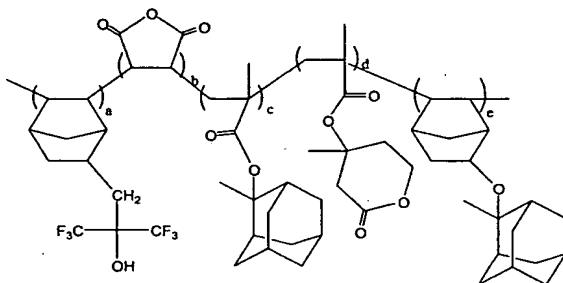
Formula 1d

;

Formula 1e

;

Formula 1f

Formula 1gFormula 1h

wherein

the relative ratio of a : b : c : d is in the range of 1~20 mol% : 1~20 mol% : 10~60 mol% : 1~40 mol% ; and

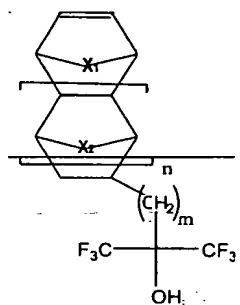
the relative ratio of a : b : c : d : e is in the range of 1~20 mol% : 1~20 mol% : 10~60 mol% : 1~40 mol% : 0~30 mol%.

Claim 5 (currently amended) A method for forming a photoresist polymer[[,]] comprising the step of:

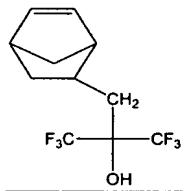
- (a) dissolving maleic anhydride, a compound of Formula [[2]] 2a, a compound of Formula 3, a compound of Formula 4 and optionally a compound of Formula [[5]] 5a in a polymerization solvent;
- (b) adding a polymerization initiator in the resulting solution of step (a); and

(c) reacting the resulting solution of step (b) under a nitrogen or argon atmosphere to obtain a polymer ~~having repeating unit of following Formula 1 of claim 4~~ at a temperature ranging from 60 to 70 °C for 4 to 24 hours.

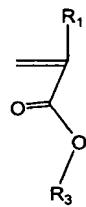
Formula 2



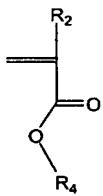
Formula 2a

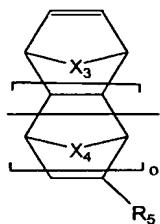
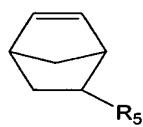
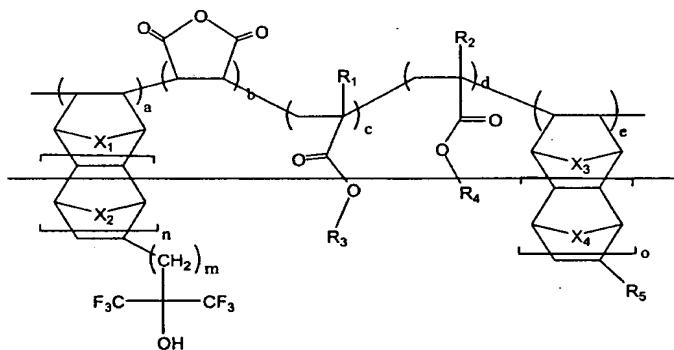


Formula 3



Formula 4



Formula 5Formula 5aFormula 1

wherein

~~X₁, X₂, X₃ and X₄ individually are selected from the group consisting of CH₂, CH₂CH₂, O and S;~~

~~R₁ and R₂ individually are selected from the group consisting of H, CH₃ and CF₃;~~

~~R₃ is selected from the group consisting of an acid labile protecting group, C₁-C₂₀-alkyl and C₁-C₂₀-cycloalkyl;~~

~~R₄ is C₁-C₂₀-hydroxyalkyl, C₁-C₂₀-hydroxyalkyl having halogen substituent, C₅-C₁₀-alkyl including an ether, C₅-C₁₀-alkyl including an ester group, C₅-C₁₀-cycloalkyl including an ether and C₅-C₁₀-cycloalkyl including an ester group;~~

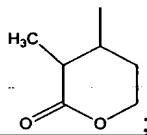
~~R₅ is selected from the group consisting of H, C₁-C₂₀ alkyl, C₁-C₂₀ alkyl carboxylate and -O-R₇, wherein R₇ is C₁-C₂₀ cycloalkyl;~~

~~m is an integer ranging from 0 to 2;~~

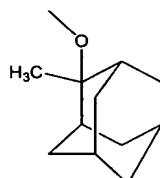
~~n is an integer of 0 or 1; and~~

R₁ and R₂ are CH₃;

R₃ is t-butyl or 2-methyl-2-adamantyl;



R₄ is C₁-C₂ hydroxyalkyl or 



R₅ is H, t-butyl carboxylate or 

the relative ratio of a : b : c : d : e in the range of 1~20 mol% : 1~20 mol% : 10~60 mol% : 1~40 mol% : 0~30 mol%.

Claims 6 (original) The method according to claim 5, wherein the polymerization solvent of step (a) is selected from the group consisting of cyclohexanone, cyclopentanone, tetrahydrofuran, dimethylformamide, dimethylsulfoxide, dioxane, methylethylketone, benzene, toluene, xylene and mixtures thereof.

Claim 7 (original) The method according to claim 5, wherein the polymerization initiator of step (b) is selected from the group consisting of benzoylperoxide, 2,2'-azobisisobutyronitrile (AIBN), acetylperoxide, laurylperoxide, t-butylperacetate, t-butylhydroperoxide and di-t-butylperoxide.

Claim 8 (original) The method according to claim 5, wherein the polymer obtained from step (c) is crystallized and purified using single or mixture solution selected from the group consisting of dimethylether, petroleum ether, methanol, ethanol, lower alcohol including iso-propanol, and water.

Claim 9 (currently amended) A photoresist composition comprising [[a]] the photoresist polymer of claim [[1]] 4, a photoacid generator and an organic solvent.

Claim 10 (original) The photoresist composition according to claim 9, wherein the photoacid generator is selected from the group consisting of phthalimidotrifluoromethane sulfonate, dinitrobenzyltosylate, n-decyl disulfone and naphthylimido trifluoromethane sulfonate.

Claim 11 (original) The photoresist composition according to claim 9, wherein the photoacid generator comprises

- (i) a first photoacid generator is selected from the group consisting of phthalimidotrifluoromethane sulfonate, dinitrobenzyltosylate, n-decyl disulfone and naphthylimido trifluoromethane sulfonate; and
- (ii) a second photoacid generator is selected from the group consisting of diphenyl iodide hexafluorophosphate, diphenyl iodide hexafluoroarsenate, diphenyl iodide hexafluoroantimonate, diphenyl p-methoxyphenylsulfonium triflate, diphenyl p-toluenylsulfonium triflate, diphenyl p-isobutylphenylsulfonium triflate, triphenylsulfonium hexafluororarsenate, triphenylsulfonium hexafluoro-antimonate, triphenylsulfonium triflate, and dibutyl-naphthylsulfonium triflate.

Claim 12 (original) The photoresist composition according to claim 9, wherein the photoacid generator is present in an amount ranging from 0.05 to 10 wt% to the photoresist polymer.

Claim 13 (original) The photoresist composition according to claim 9, wherein the organic solvent is selected from the group consisting of diethylene glycol diethyl ether, methyl 3-methoxypropionate, ethyl 3-ethoxypropionate, propylene glycol methyl ether acetate, cyclohexanone, 2-heptanone, and ethyl lactate.

Claim 14 (original) The photoresist composition according to claim 9, wherein the organic solvent is present in an amount ranging from 500 to 2000 wt% to the photoresist polymer.

Claim 15 (original) A method for forming a photoresist pattern, comprising the step of:

- (a) coating the photoresist composition of claim 9 on a wafer to form a photoresist film;
- (b) exposing the photoresist film to light;
- (c) baking the exposed photoresist film; and
- (d) developing the photoresist film to obtain a photoresist pattern.

Claim 16 (original) The method according to claim 15, further comprising performing a bake process before exposure of step (b).

Claim 17 (original) The method according to claim 15, wherein the bake process is performed at a temperature ranging from 70 to 200 °C.

Claim 18 (original) The method according to claim 15, wherein the light is selected from the group consisting of KrF, ArF, EUV (Extreme Ultra Violet), VUV (Vacuum Ultra Violet), E-beam, X-ray and ion beam.

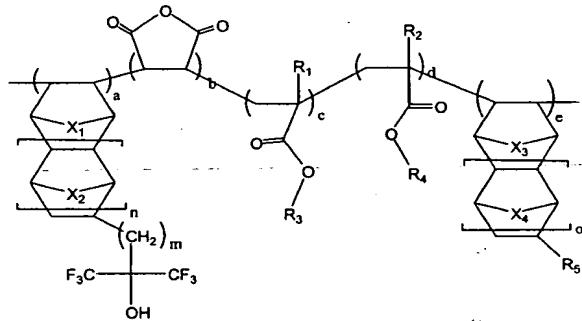
Claim 19 (original) The method according to claim 15, wherein the exposure process is performed with exposure energy ranging from 0.1 to 100 mJ/cm².

Claim 20 (original) The method according to claim 15, wherein the development of step (d) is performed using an alkaline developing solution.

Claim 21 (new) A photoresist composition comprising:

a photoresist polymer comprising a repeating unit represented by Formula 1, a photoacid generator and an organic solvent,

Formula 1



wherein

X₁, X₂, X₃ and X₄ individually are selected from the group consisting of CH₂, CH₂CH₂, O and S;

R₁ and R₂ individually are selected from the group consisting of H, CH₃ and CF₃;

R₃ is selected from the group consisting of an acid labile protecting group, C₁-C₂₀ alkyl and C₁-C₂₀ cycloalkyl;

R₄ is selected from the group consisting of C₁-C₂₀ hydroxyalkyl, C₁-C₂₀ hydroxyalkyl having halogen substituent, C₅-C₁₀ alkyl including an ether group, C₅-C₁₀ alkyl including an ester group, C₅-C₁₀ cycloalkyl including an ether group, and a C₅-C₁₀ cycloalkyl including an ester group;

R₅ is selected from the group consisting of H, C₁-C₂₀ alkyl, C₁-C₂₀ alkyl carboxylate, and -O-R₇, wherein R₇ is C₁-C₂₀ cycloalkyl;

m is an integer ranging from 0 to 2;

n is an integer of 0 or 1; and

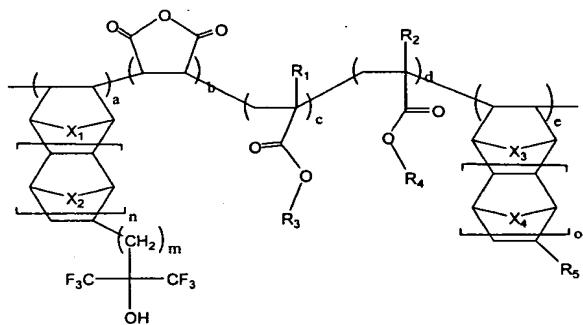
the relative ratio of a : b : c : d : e is in the range of 1~20 mol% : 1~20 mol% : 10~60 mol% : 1~40 mol% : 0~30 mol%; and

wherein the photoacid generator selected from the group consisting of phthalimidotrifluoromethane sulfonate, dinitrobenzyltosylate, n-decyl disulfone and naphthylimido trifluoromethane sulfonate.

Claim 22 (new) A photoresist composition comprising:

a photoresist polymer comprising a repeating unit represented by Formula 1, a photoacid generator and an organic solvent,

Formula 1



wherein

X₁, X₂, X₃ and X₄ individually are selected from the group consisting of CH₂, CH₂CH₂, O and S;

R₁ and R₂ individually are selected from the group consisting of H, CH₃ and CF₃;

R₃ is selected from the group consisting of an acid labile protecting group, C₁-C₂₀ alkyl and C₁-C₂₀ cycloalkyl;

R₄ is selected from the group consisting of C₁-C₂₀ hydroxyalkyl, C₁-C₂₀ hydroxyalkyl having halogen substituent, C₅-C₁₀ alkyl including an ether group, C₅-C₁₀ alkyl including an ester group, C₅-C₁₀ cycloalkyl including an ether group, and a C₅-C₁₀ cycloalkyl including an ester group;

R₅ is selected from the group consisting of H, C₁-C₂₀ alkyl, C₁-C₂₀ alkyl carboxylate, and -O-R₇, wherein R₇ is C₁-C₂₀ cycloalkyl;

m is an integer ranging from 0 to 2;

n is an integer of 0 or 1; and

the relative ratio of a : b : c : d : e is in the range of 1~20 mol% : 1~20 mol% : 10~60 mol% : 1~40 mol% : 0~30 mol%; and

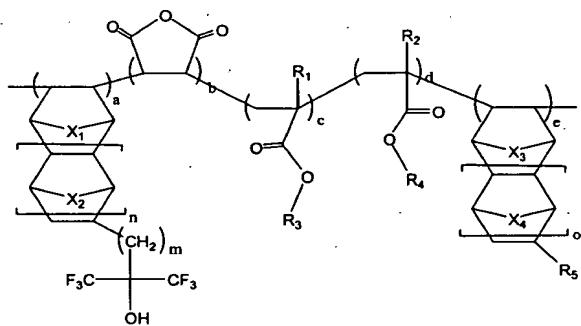
wherein the photoacid generator comprises

- (i) a first photoacid generator is selected from the group consisting of phthalimidotrifluoromethane sulfonate, dinitrobenzyltosylate, n-decyl disulfone and naphthylimido trifluoromethane sulfonate; and
- (ii) a second photoacid generator is selected from the group consisting of diphenyl iodide hexafluorophosphate, diphenyl iodide hexafluoroarsenate, diphenyl iodide hexafluoroantimonate, diphenyl p-methoxyphenylsulfonium triflate, diphenyl p-toluenylsulfonium triflate, diphenyl p-isobutylphenylsulfonium triflate, triphenylsulfonium hexafluororarsenate, triphenylsulfonium hexafluoro-antimonate, triphenylsulfonium triflate, and dibutyl-naphthylsulfonium triflate.

Claim 23 (new) A method for forming a photoresist pattern, comprising:

(a) coating a photoresist composition on a wafer to form a photoresist film, the photoresist composition comprising a photoresist polymer, a photoacid generator and an organic solvent, the photoresist polymer comprising a repeating unit of the following

Formula 1



wherein

X₁, X₂, X₃ and X₄ individually are selected from the group consisting of CH₂, CH₂CH₂, O and S;

R₁ and R₂ individually are selected from the group consisting of H, CH₃ and CF₃;

R₃ is selected from the group consisting of an acid labile protecting group, C₁-C₂₀ alkyl and C₁-C₂₀ cycloalkyl;

R₄ is selected from the group consisting of C₁-C₂₀ hydroxyalkyl, C₁-C₂₀ hydroxyalkyl having halogen substituent, C₅-C₁₀ alkyl including an ether group, C₅-C₁₀ alkyl including an ester group, C₅-C₁₀ cycloalkyl including an ether group, and a C₅-C₁₀ cycloalkyl including an ester group;

R₅ is selected from the group consisting of H, C₁-C₂₀ alkyl, C₁-C₂₀ alkyl carboxylate, and -O-R₇, wherein R₇ is C₁-C₂₀ cycloalkyl;

m is an integer ranging from 0 to 2;

n is an integer of 0 or 1; and

the relative ratio of a : b : c : d : e is in the range of 1~20 mol% : 1~20 mol% : 10~60 mol% : 1~40 mol% : 0~30 mol%;

(b) exposing the photoresist film to light with an exposure energy ranging from 0.1 to 100 mJ/cm²;

(c) baking the exposed photoresist film; and

(d) developing the photoresist film to obtain a photoresist pattern.